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(56) Documents cited
GB 2220533 A GB 2187345 A GB 2175463 A
EP 0402277 A1 US 4342947 A US 3869641 A

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(54) Power supply circuit for indicator

(57) An indicator, such as an LED or incandescent lamp, of low current consumption powered from an A.C. supply, which is itself unsuitable for powering the indicator directly via a capacitor C which provides voltage-dropping and current limiting functions. Capacitor C is discharged by a high volume resistor R2 when the circuit is switched off and a resistor R1 helps to limit surge currents when the circuit is switched on. A multiplicity of such circuits may be provided on a common circuit board with lamp test inputs T4 connected to a common lamp test switch (S), (Fig. 2).

For a large control system, eg in a power station, an illustration of the system may be formed by wall or image tiles (10), (Fig. 3), depicting on their surfaces representations of controlled components and connections therebetween, the tiles including condition indicative LED's energised via circuits, as in Fig. 1, mounted on the backs of the tiles.

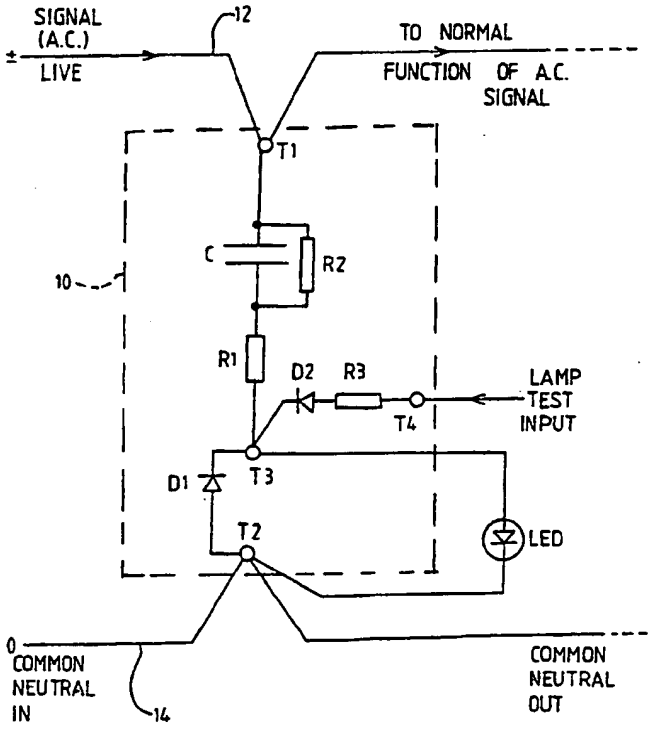

FIG 1

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1990.

GB 2 252 685 A

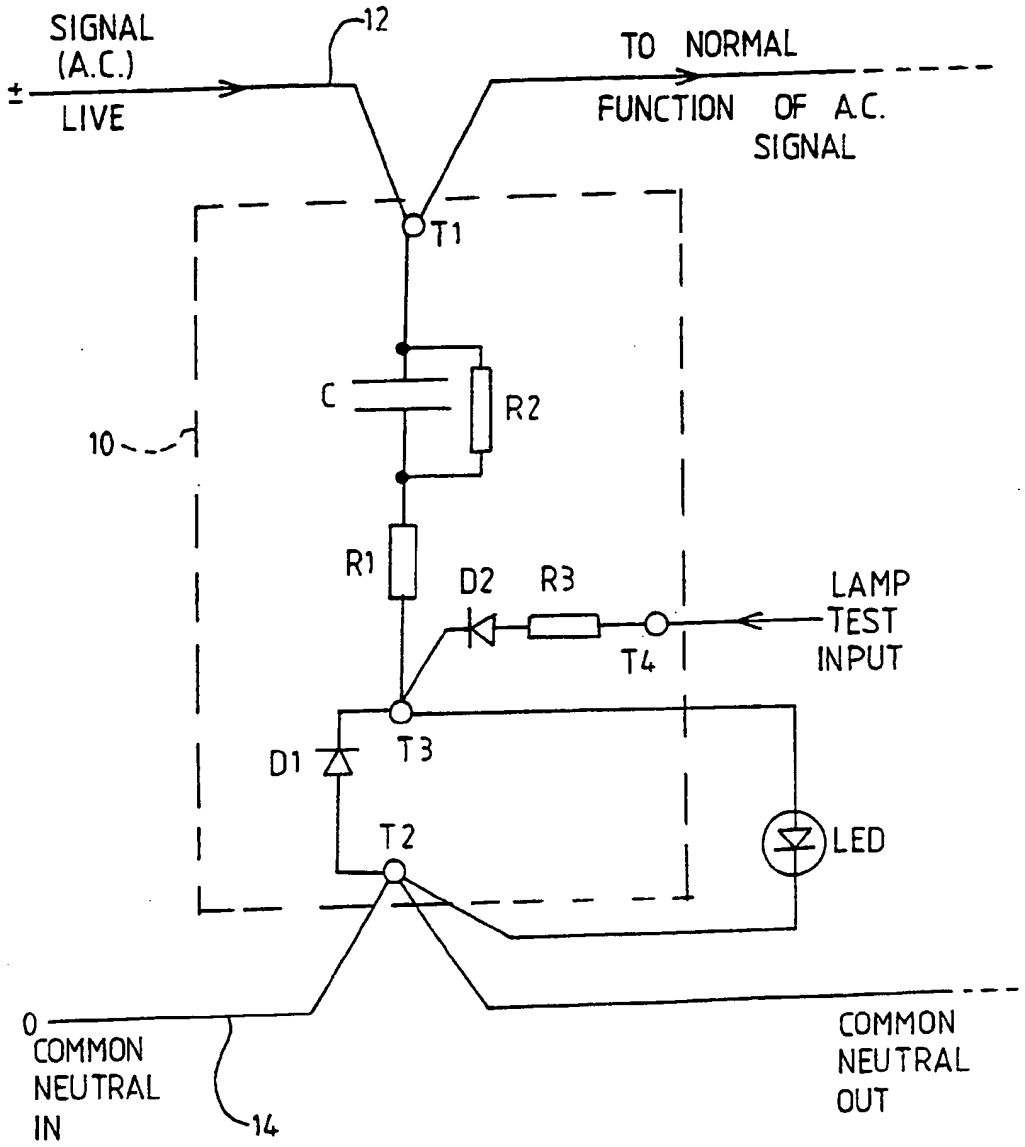

FIG 1

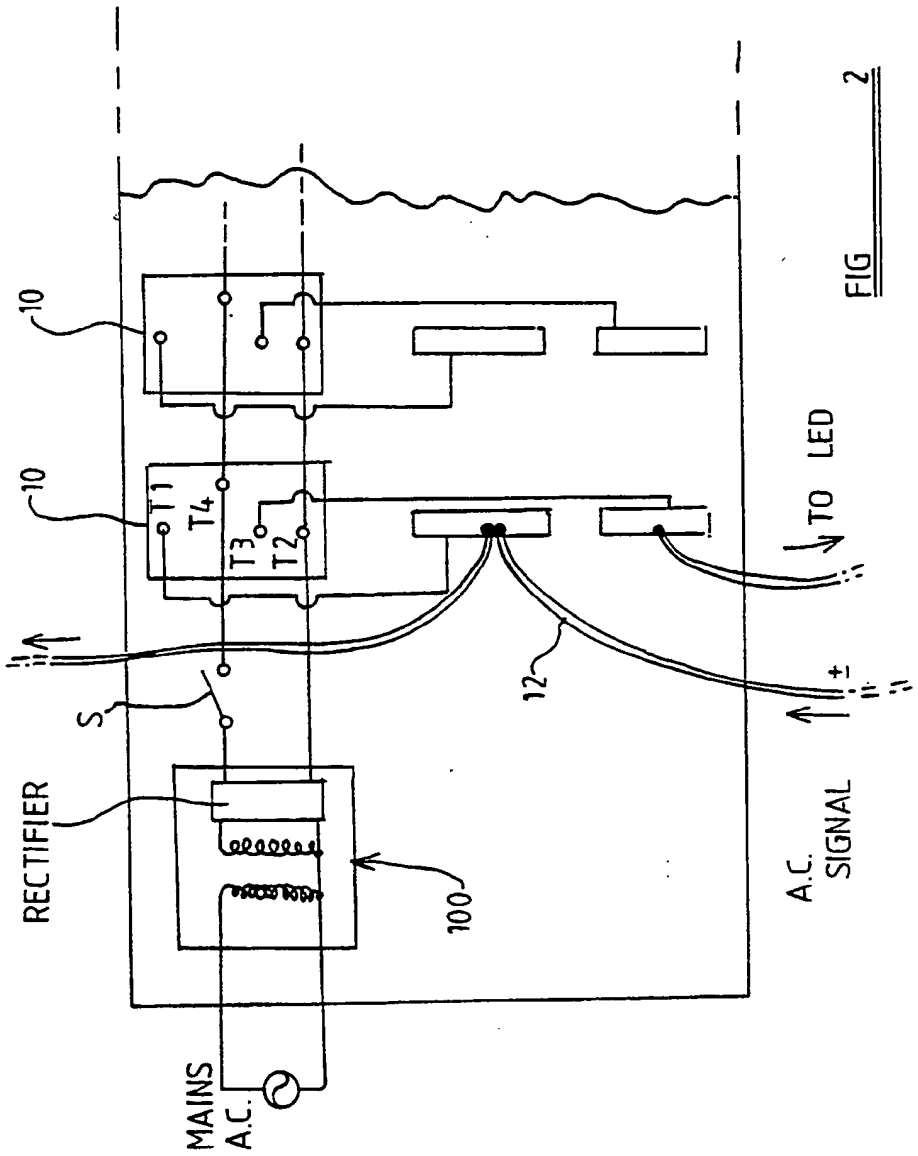

FIG 2

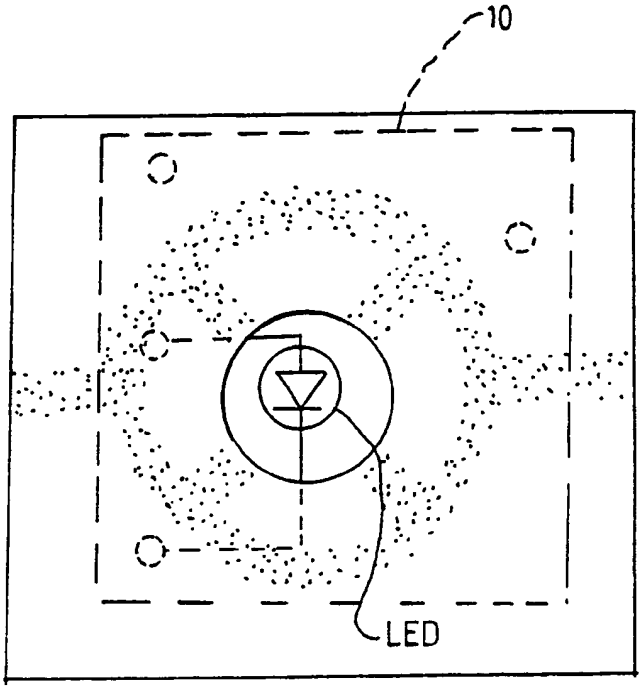

FIG 3

BNSDOCID. <GB 2252885A 1 >

Title:"Power supply circuit"

Description of the Invention

This invention relates to an electrical power supply circuit, and is particularly concerned with an electrical power supply circuit for enabling a low current indicator to be powered from an alternating electrical supply which is itself not suitable for powering the indicator directly.

By the term "low current indicator" we mean an indicator which requires a relatively low current to provide a (relatively low power) visible output, for example a light emitting diode (LED) or an incandescent lamp of comparable size and visual brightness to an LED.

The invention is specifically concerned with the technical field of providing a visual indication of the condition (e.g. on or off or the like) of an item of plant. Typically, operation of such items of plant from a mains supply or comparable voltage leads to the ready availability of alternating voltages, of approximately mains magnitude, which in principle may be utilised for the indication of the condition of the item of plant, but such signals are not suitable for direct powering of a low current indicator such as an LED for example, since they are of too high a voltage and too low an impedance.

It is the widespread and wholly accepted practice in said field to provide a limited current at a reduced voltage for direct current powering of a low current indicator such as an LED, by way of a network or networks of resistors and diodes, but these conventional techniques present significant problems in terms of the bulk of the circuitry of such networks, and excessive ohmic heating arising from the resistors, leading to heat dissipation problems. These difficulties are particularly great in relation to systems involving a large number of such low current indicators, each with their own such circuitry and its associated bulk and heating problems.

It is an object of the invention to overcome, or at least substantially reduce, said problems.

According to a first aspect of the present invention, there is provided an electrical power supply circuit for enabling a low current indicator to be powered from an alternating electrical supply which is itself unsuitable for powering the indicator directly, wherein a voltage-dropping and current limiting function, to provide an output voltage and current compatible with such an indicator, is performed by an at least substantially wholly reactive component or sub-circuit.

Preferably said function is performed by a capacitance connected in series with the indicator to be powered.

The indicator may conveniently be a light emitting diode (LED). Such a diode conducts in one sense only, and a conventional diode may be connected in parallel across the light emitting diode but such as to conduct in the opposite sense, to provide a return current path during those parts of an alternating cycle in which the LED is not conductive.

Preferably a resistance is connected in series between the indicator and the capacitance, for limiting surge currents.

Preferably a relatively large resistance is connected in parallel across the capacitance, for permitting gradual discharge of the capacitance if the circuit is switched off.

Preferably the circuit provides for "lamp test" means for testing correct operation of the indicator, and said means may comprise an input at which a low voltage compatible with powering the indicator may be connected. Preferably the lamp test input includes a resistance to limit current through the indicator to an acceptable level, and preferably further comprises diode means, operative in circumstances in which a plurality of such circuits are connected with a common lamp test input, for preventing spurious operation of the indicators of others of said circuits.

According to a second aspect of the invention, there is provided a power supply unit comprising a plurality of power supply circuits in accordance with the first aspect of the invention, the circuits receiving respective inputs from respective plant items, for powering respective low current indicators.

Preferably a common neutral connection is provided for said circuits, and preferably a common lamp test function is provided; power for the latter may for example be derived from transformer means also included in the power supply unit.

According to a third aspect of the invention, there is provided a circuit in accordance with the first aspect of the invention, in combination with (e.g. pre-connected to) a low current indicator to be powered thereby. In preferred embodiments said combination is in the form of an "image tile" bearing on its front surface an illustration or symbol representative of a component being monitored, constructed and arranged such that the indicator is visible to a user, and such that said circuit is accommodated on the tile, such as on or adjacent to a rear surface thereof.

Embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:-

FIGURE 1 illustrates diagrammatically an electrical power supply circuit in accordance with the invention, and a low current indicator powered thereby;

FIGURE 2 illustrates a power supply unit in accordance with the invention, comprising a plurality of the circuits of Figure 1, for receiving respective inputs and powering respective low current indicators; and

FIGURE 3 illustrates an image tile in accordance with the invention incorporating an electrical power supply circuit such as that of Figure 1.

Referring first to Figure 1 of the drawings, an electrical power supply circuit 10 in accordance with the invention is specifically for enabling a small size low current indicator, in this example a light emitting diode LED requiring only about 15 mA of current in order to be illuminated, to be powered from an alternating current signal which is itself unsuitable, due to being of too high a voltage (e.g. about 110 volts or about 240 volts) and too low an impedance, to power the LED directly.

The circuit 10 relates specifically to the technical field of providing a visual indication, by way of said indicator LED, of the

condition (e.g. on or off, or open or closed, or correctly functioning or faulty) of an item of plant, for example a pump or valve, remote from the circuit. Typically, operation of such items of plant involves alternating voltages of mains magnitude such as about 110 volts or about 240 volts, such that in general alternating signals at such a voltage are readily available as means for determining the condition of the item of plant, in that for example such signals may be present when the item is operative but not present when the item is not operative, but these signals are not suitable for direct powering of a low current indicator such as a LED for example, for the reasons stated above.

In the circuit 10, current limitation to provide an output suited to the LED indicator is achieved, in accordance with the present invention, by the use of at least substantially wholly reactive circuitry, enabling such current limitation, and an associated voltage drop to a level compatible with the LED, to be so achieved with little or no heat dissipation in the circuitry so used. Moreover the reactive circuitry is compact.

In this manner, the disadvantages of bulk and excessive ohmic heating, associated with known techniques of utilising networks of resistors and diodes to provide such a function are avoided completely or at least substantially reduced.

Such considerations are particularly important in relation to large systems where for example there may be about 200 or 300 such LEDs indicating the conditions of respective items of plant, in relation to which conventional techniques may generate perhaps 500W of waste heat, leading to obvious cooling problems.

In more detail, in relation to the circuit 10 of the invention, when a particular plant item is operative, a condition indicating alternating signal is supplied from the plant item concerned via a respective line 12 to an input terminal T1 of the circuit 10 and from there passes on to an electrical control circuit and/or computer (not shown) controlling the operation of the plant. Similarly, a common neutral line 14 for said item and other items of plant passes to, and thereon from, a further terminal

T2 of the circuit 10. The circuit 10 further comprises an indicator output terminal T3, and the LED indicator to be illuminated is connected between the terminals T2 and T3, to be capable of conducting current in the direction from T3 to T2.

A diode D1 is connected between terminals T2 and T3, such as to be capable of conducting current in the direction T2 to T3.

Between terminals T1 and T3 there are connected, in series, a capacitor C, and resistor R1. In this context, the capacitor C is of primary importance, providing a purely reactive impedance for providing the current limitation, and associated voltage drop, desired. A further resistor R2 is connected in parallel across the capacitor C.

The circuit further comprises a lamp test input terminal T4, and between the terminals T3 and T4 there are connected a further resistance R3 and in series therewith a further diode D2 arranged so as to be capable of conducting current in the direction from T4 to T3.

The operation of the circuit 10 is as follows:

Due at least principally to the capacitance C, the current which is allowed to flow through the LED is limited to a suitable level by purely reactive means, so avoiding ohmic heating problems, and in compact manner. In this example the current flow through the LED during the LED-conductive part of each AC cycle on line 12 is no more than about 15mA (r.m.s.) being the correct current level for illumination of said LED and the capacitance C is calculated so as to provide a reactance which limits the current in this way. At the same time the voltage across the LED is dropped to a required level of approximately 1 volt, owing to the presence of capacitance C. For 110V A.C. signals on line 12, suitable values for the capacitance C may be about 0.47 microfarad or about 0.68 microfarad, while for 240V signals a value of about 0.33 microfarad may be suitable. Diode D1 is provided so as to provide a return path for the current, during the other half of each cycle when the LED is not conductive. The other components are present by way of refinement. Thus, the resistance R1 is provided to help limit surge currents (such as

might occur if a switch on or for the plant item concerned were operated when the A.C. was at a peak), and the resistance R2, e.g. about 1 megohm, is to permit discharge of the capacitor C in the event that the circuit is switched off at a time when capacitor C is charged.

The lamp test input is provided to enable operation of the LED to be checked. When a 4.5volts d.c. (approx) input is provided at terminal T4 this will cause a current flow through the LED if the latter is not faulty. R3 is chosen such that together with the diode D2 and diodes of a rectifier circuit (not shown) it limits this current to the aforesaid 15 mA (approx). The Diode D2 is important where a plurality of circuits 10 are employed, with a common lamp test input connection, otherwise the main current through one of the circuits 10 could flow via the lamp test input connection into the other circuits to illuminate one or more of the LEDs of one or more of the other such circuits 10.

It is to be noted that operation of the lamp test input does not result in feedback to the plant item being monitored, since the d.c. test voltage applied at terminal T4 is blocked from the line 12 by the presence of the capacitor C.

In the power supply unit of Figure 2 a plurality (e.g. between 10 and 20) of such circuits 10 are provided on a common circuit board, to receive respective a.c. inputs, for monitoring purposes, from respective plant items, and to operate respective LEDs to indicate the conditions of said items. A common neutral line serves all of the circuits 10, and each circuit 10 has its terminals T1 and T3 connected to a respective pair of conductive tags on the circuit board, for providing connection to external wiring. A mains powered transformer 100 provides a stepped-down rectified d.c. output which on closing of a switch S provides a common lamp test input voltage to all of the circuits 10 simultaneously. Such a circuit board is highly compact, and involves a minimum of external wiring, the external wiring for connection to the first of the circuits 10 being as illustrated in the drawing, and similarly for the other circuits 10. The invention enables a plurality of such circuits 10 to be so mounted closely adjacent to each

other, whilst avoiding overheating problems such as were experienced in the prior art.

For large systems (e.g. control functions in power stations), an illustration of the system under control may be provided which occupies a large part of a wall of a room, the illustration being formed from a plurality of "wall" tiles (image tiles) depicting on their surfaces representations of individual components and connections therebetween, and including condition-indicative low current indicators such as LEDs, in the tiles, to indicate the condition of the illustrated components. Where such indicators are powered in conventional manner, again there are problems of heat and bulk, for with hundreds of such tiles, at least some of the circuitry for providing a current limitation is too bulky to be accommodated directly behind the tiles, leading to extensive wiring to locations remote from the tiles, and the usual heat problems. In the image tile shown in Figure 3, in accordance with the invention, these problems are avoided. In Figure 3, the LED of the image tile, for indicating the condition of the flow valve, is connected to a circuit 10 in accordance with the invention (illustrated only schematically in outline) which by virtue of the nature and values of its components, may conveniently be mounted directly on the back of the tile, achieving a substantial reduction in the amount of external wiring required, whilst avoiding problems of excessive heat generation behind the tiles.

It will be appreciated that in relation to all the above embodiments, elimination or substantial reduction of ohmic heating losses enables reduced running costs to be achieved.

The features disclosed in the foregoing description, or the accompanying drawings, expressed in their specific forms or in terms of a means for performing the disclosed function, or a method or process for attaining the disclosed result, as appropriate, may, separately or in any combination of such features, be utilised for realising the invention in diverse forms thereof.

CLAIMS:

1. An electrical power supply circuit for enabling a low current indicator to be powered from an alternating electrical supply which is itself unsuitable for powering the indicator directly, wherein a voltage-dropping and current limiting function, to provide an output voltage and current compatible with such an indicator, is performed by an at least substantially wholly reactive component or sub-circuit.

2. An electrical power supply circuit according to Claim 1 wherein said function is performed by a capacitance connected in series with the indicator to be powered.

3. An electrical power supply circuit according to Claim 2 wherein the indicator is a light emitting diode (LED).

4. An electrical power supply circuit according to Claim 3 wherein a conventional diode is connected in parallel across the light emitting diode but such as to conduct in the opposite sense.

5. An electrical power supply circuit according to any one of Claims 2 to 4 wherein a resistance is connected in series between the indicator and the capacitance, for limiting surge currents.

6. An electrical power supply circuit according to any one of Claims 2 to 5 wherein a relatively large resistance is connected in parallel across the capacitance, for permitting gradual discharge of the capacitance if the circuit is switched off.

7. An electrical power supply circuit according to any one of the preceding claims wherein the circuit provides for "lamp test" means for testing correct operation of the indicator.

8. An electrical power supply circuit according to claim 7 wherein said "lamp test" means comprises an input at which a low voltage compatible with powering the indicator may be connected.

9. An electrical power supply circuit according to Claim 8 wherein the lamp test input includes a resistance to limit current through the indicator to an acceptable level.

10. An electrical power supply circuit according to Claim 9 further comprising diode means operative in circumstances in which a plurality of such circuits are connected with a common lamp test input, for preventing spurious operation of the indicators of others of said circuits.

11. An electrical power supply circuit substantially as hereinbefore described with reference to and/or as illustrated in the accompanying drawings.

12. A power supply unit comprising a plurality of power supply circuits in accordance with any one of Claims 1 to 11, the circuits receiving respective inputs from respective plant items, for powering respective low current indicators.

13. A power supply unit according to Claim 12 wherein a common neutral connection is provided for said circuits.

14. A power supply unit according to Claim 13 wherein a common lamp test function is provided.

15. A power supply unit according to Claim 14 wherein power for the common lamp test function is derived from transformer means also included in the power supply unit.

16. A power supply unit substantially as hereinbefore described with reference to and/or as illustrated in the accompanying drawings.

17. A circuit in accordance with any one of Claims 1 to 11, in combination with a low current indicator to be powered thereby.

18. The combination of Claim 17, being in the form of an "image tile" bearing on its front surface an illustration or symbol representative of a component being monitored, constructed and arranged such that the indicator is visible to a user, and such that said circuit is accommodated on the tile.

19. The combination of Claim 18 wherein said circuit is accommodated on or adjacent to a rear surface of the tile.

20. An electrical power supply circuit in combination with a low current indicator to be powered thereby, substantially as hereinbefore described with reference to and/or as illustrated in the accompanying drawings.

21. Any novel feature or novel combination of features described herein and/or illustrated in the accompanying drawings.

Patents Act 1977
Examiner's report to the Comptroller under Section 17 (The Search Report)

Application number
9102700.3

Relevant Technical fields

(i) UK Cl (Edition K) H2H HLL3, HLL4

(ii) Int CL (Edition 5) H05B 33/08,37/00,37/02,39/00, 39/02,39/04,39/06,39/08,39/09; G01R 19/145,19/155

Search Examiner
M J BILLING

Databases (see over)

(i) UK Patent Office

(ii)

Date of Search
14 APRIL 1992

Documents considered relevant following a search in respect of claims 1 TO 19

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
X Y	GB 2220533 A (AMOURGAM) - Eg see Figures 2, 4, 5, 6	1-5, 12, 17 7 to 10, 13, 14
X Y	GB 2187345 A (DIEHL) - Eg see Figures R1, C1 LED 4 in Figure 1	1, 2, 3, 5, 17 7 to 10, 12, 13, 14
X Y	GB 2175463 A (HOWARD) Eg see Figures 1, 4C; abstract	1, 2, 6, 17 2 to 10, 12, 13, 14
X Y	EP 0402277 A1 (MERLIN GERIN) Eg see Figures 1, 2	1, 2, 3, 5, 17 7 to 10, 12, 13, 14
Y	US 4342947 A (BLOYD) - Whole document	7 to 10, 12, 13, 14

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Category	Identity of document and relevant passages	Relevant to claim(s)

Categories of documents

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13

Patents Act 1977
Examiner's report to the Comptroller under S tion 17 (The Search Report)

Application number
9102700.3

Relevant Technical fields

(i) UK Cl (Edition) Contd. from page 2

(ii) Int CL (Edition)

Search Examiner
M J BILLING

Databases (see over)

(i) UK Patent Office

(ii)

Date of Search
14 APRIL 1992

Documents considered relevant following a search in respect of claims

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
X	US 3869641 A (MONSANTO) - Whole document	1-5, 17
Y		7 to 10, 12, 13, 14

SF2(p)

kg - c:\wp51\doc99\fil000948

Category	Identity of document and relevant passages	Relevant to claim(s)

Categories of documents

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